



ORIGINAL ARTICLE

Prognostic utility of negative stress/rest myocardial SPECT studies among patients with different clinical categories of chronic kidney disease: Data from an Egyptian cohort



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Abstract Prognostic value of negative myocardial SPECT study is well established. However, patients with chronic kidney disease (CKD) are a special group showing increased risk of cardiac events. We thought to investigate the prognostic value of negative SPECT study among patients on regular hemodialysis compared to other clinical categories of CKD.

Methods: 186 consecutive patients with CKD and negative SPECT study were enrolled. 93 (50%) were on hemodialysis with an eGFR < 30 mL/min/1.73 m² (Group I); 25 (13.4%) had uncomplicated renal transplantation with eGFR between 45 and 90 mL/min/1.73 m² (Group II) and 68 (36.6%) with CKD on conservative management and no prior history of hemodialysis (eGFR between 30 and 60 mL/min/1.73 m²), Group (III). End points (CD, STEMI/NSTEMI, need for revascularization and hospitalized HF) were traced at 6 months, one year and 2 years.

Results: Total events in all groups were 5 (2.70%) at 6 months, and 18 (9.70%) and 36 (19.30%) at one year and 2 years respectively. At one year 16 (17.20%) cardiac events happened in Group I compared to one (4.0%) and one (1.50%) event(s) in Groups II and III respectively (*p* values 0.001). At 2 years, 29 (31.20%) cardiac events happened in Group I while 2 (8.0%) and 5 (7.30%) happened in Groups II and III respectively (*p* values 0.01, 0.001 respectively). eGFR and duration of hemodialysis were the independent predictors of cardiac events.

Abbreviations: BMI, Body mass index; CD, cardiac death; CKD, chronic kidney disease; EF%, ejection fraction; eGFR, estimated glomerular filtration rate; HF, heart failure; LHR, lung heart ratio; LV, left ventricle; LVED volume, LV end-diastolic volume; LVES volume, LV end-systolic volume; LVH, left ventricular hypertrophy; METs, metabolic equivalents; MI, myocardial infarction; MPI, myocardial perfusion imaging; NPV, negative predictive value; NSTEMI, non-ST elevation myocardial infarction; PCI, percutaneous coronary intervention; CABG, coronary artery bypass surgery; SD, standard deviation; SPECT, single photon emission computed tomography; SSS, summed stress score; SRS, summed rest score; SDS, summed difference score; STEMI, ST elevation myocardial infarction

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Conclusion: Despite negative MPI study, patients on hemodialysis showed higher event (including CD, STEMI/NSTEMI and revascularization) rate at one and 2 years of follow-up compared to other clinical categories of CKD.

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1. Introduction

Negative predictive value (NPV) of SPECT scans for detection of myocardial infarction (MI) and cardiac death (CD) was shown to be in the neighborhood of 98.8% (95% confidence interval [CI] 98.5–99.0) during 36 months of follow-up.¹ Patients with chronic kidney disease (CKD) are at increased risk of early and progressive coronary artery disease (CAD).² Data coming from Egyptian centers discussing value of SPECT in patients with CKD are lacking. Hence, we thought to evaluate the prognostic value of negative SPECT studies among Egyptian patients on regular hemodialysis compared to other clinical categories of CKD.

2. Methods

2.1. Study cohort

The study cohort consisted of 193 consecutive patients referred for ^{99m}Tc sestamibi gated SPECT study at Al-Azhar school of medicine (Cairo, Egypt), and Alfa scan center (Heliopolis, Cairo, Egypt) nuclear cardiac laboratories between September 2011 and May 2013. Seven patients were excluded due to non-cardiac deaths during the follow-up period. All enrolled patients had a documented CKD. The study population was divided into 3 groups according to the main treatment received for CKD. *Group (I)*, 93 patients (50%) were on regular hemodialysis with an eGFR < 30 mL/min/1.73 m². *Group (II)*, 25 patients (13.4%) had uncomplicated renal transplantation surgery after variable period of hemodialysis with eGFR values between 45 and 90 mL/min/1.73 m². *Group (III)*, 68 patients (36.6%) had CKD (eGFR between 30 and 60 mL/min/1.73 m²) on conservative medical management of CKD and no prior history of hemodialysis. Mean period of hemodialysis among Group I was 3 ± 2.2 years while mean period of hemodialysis among Group II before renal transplantation surgery was 2.5 ± 1.9 years.

All patients enrolled on this study had a negative myocardial SPECT study. All patients with quantitatively and qualitatively normal myocardial perfusion on SPECT, who showed any other high risk non-perfusion abnormalities (e.g. namely stress induced LV cavity dilatation and stress induced myocardial stunning), were excluded for sake of reproducibility. All patients with advanced comorbidities (e.g. cancer, advanced liver failure) were also excluded. Patients post-renal transplantation with rejection (acute, sub-acute or chronic) who are currently on regular dialysis were excluded for sake of reproducibility. Patients with echocardiographic data of significant valvular heart disease, pericardial disease or LV systolic dysfunction (EF% < 50%) were also excluded.

2.2. Stress protocol

A total of 109 (58.6%) patients underwent treadmill exercise stress according to the standard *Bruce* protocol. 77 (41.4%) had pharmacologic stress using *Dipyridamole* according to the standard infusion protocol.^{7,8} Stress testing was symptom-limited. Premature termination of the stress test was done according to the recommendations in the updated guidelines of exercise testing.^{7,8}

2.3. Myocardial perfusion imaging

All subjects underwent a gated-SPECT MPI according to a two-day protocol. Supine images were acquired with a dual-head (Philips JetStream or Siemens WorkSpace cameras) with low-energy, high-resolution collimators. All radionuclide images and associated data were processed according to the standard protocols. ^{99m}Tc sestamibi was used in all patients (the routine tracer used in our laboratories). Myocardial perfusion was calculated as a relative percent of tracer uptake in the standard model “17 segment model”.⁸

Experienced nuclear cardiology specialists used these data on a *semi-quantitative* approach to interpret each MPI study. Readers assigned a score (0–4) to each segment: (0) for normal uptake; (1, 2 and 3) for mild, moderate and severe reduction of uptake respectively; and (4) for absent uptake. Sum stress score (SSS), sum rest score (SRS) and sum difference score (SDS) were reported. Other markers of high risk perfusion scans were reported separately (e.g. increased LHR, Transient LV cavity dilatation, abnormal regional and global wall motion abnormalities). Negative SPECT study was defined as SSS < 4 and SDS = 0.

2.4. Follow-up data

6 months, one year and 2 years follow-up data were collected through telephone calls and hospital records. End points were cardiac death, STEMI/NSTEMI, the need for revascularization procedure and documented HF.

2.5. Statistical analysis

Continuous variables were expressed as mean and SD, and categorical variables were expressed as percentages. Student's *t*-tests were used to compare the groups in view of different clinical and MPI data. The primary end point was the occurrence of cardiac events, defined as cardiac death, nonfatal MI, need for revascularization procedure and documented HF. Cox regression hazard analysis was used to assess the impact of different demographic and clinical data. *p* value of less than 0.05 was considered significant. Statistical analysis

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